

# Morphology and shallow stratigraphy of the West Melilla and Cabliers CWC Mounds (Alborán Sea). Preliminary insights from the GATEWAYS MD194 Cruise

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**Abstract:** *In this study we present the main morphological characteristics of the West Melilla and Cabliers CWC Mounds (Eastern Alboran Sea) and include the preliminary results from the analysis of four gravity cores collected in the area during the GATEWAY MD194 Cruise. The West Melilla Mound field is composed of two different clusters which may have different ages. The Cabliers Mound is a 15km long CWC ridge, where large living CWC reefs, almost unique for the Mediterranean Sea, have been observed on its summit through ROV videos, thriving under moderate current regimes and intense sediment transport. High density of CWC frameworks and strong variability of CWC species suggest that the Cabliers Mound corresponds to a peculiar feature compared to the other mounds of this region. The acquired data represent a step forward in understanding the evolution of the Alboran Giant CWC Mounds in their sedimentary environment.*

**Key words:** Cold-Water Coral Mounds, Eastern Alboran Sea, Geomorphology, Gravity Cores.

## INTRODUCTION

Two different Cold-Water Coral (CWC) Mound provinces have recently been unveiled through high-resolution bathymetric mapping in the Eastern Alboran Sea (Western Mediterranean) during the MELCOR Cruise in 2011: the West Melilla Mounds, 9km west of Cape Tres Forcas (Moroccan Margin) and the Cabliers Mound, 80km northeast Cape Tres Forcas (Fig. 1). Oceanographic data clearly display the interaction of the Modified Atlantic Water (MAW) and the Levantine Intermediate Water (LIW) at a depth of around 200m. The mound fields were eventually re-visited and sampled through 4 gravity cores, from 5 to 11m long, during the GATEWAYS MD194 Cruise in 2012. The main morpho-sedimentary characteristics and preliminary results from the gravity core analyses will be presented in this study.

## RESULTS AND DISCUSSION

### The West Melilla Mounds:

Up to 103 mounds organized in two main clusters have been recognized within a depth range of 299–590 m, displaying a high density of 5 mounds.km<sup>-2</sup> (Lo Iacono et al., 2014). Mounds, 260m wide on average and 1–48m high, show a skewed distribution, with most of them less than 10m tall while only a few reach heights of up to 48m. The main central cluster, where 81 small mounds have been mapped, consists of slightly asymmetrical to circular mounds. The lobe shape of the main cluster suggests that a landslide functioned as hard substrate for the settling of CWC communities, contrasting with the surrounding fine grained seafloor (Lo Iacono et al., 2014). According to the seismic

records crossing the CWC mound field, most of these mounds appear partly draped by a transparent fine sediment layer. This is confirmed by the video images of an ROV dive, showing highly bioturbated fine sediment covers, and by the Van Veen sediment samples consisting of stiff and consolidated clays. The absence of bottom currents in ADCP data acquired in the area also confirms a prevailing depositional environment. A second cluster composed of nine mounds was mapped in the eastern portion of the study area, in a depth range of 347–430m. These mounds are the tallest and largest mapped in the West Melilla area, displaying a mean height of 28m. They develop for almost 1.5km along a NNW–SSW direction until a depth of 500m. The deepest sections of the mounds are buried under fine-grained sediments, which according to the seismic records can vary from 1 to 12m. The mounds of the second cluster are rooted on a single unconformity which suggests a common start-up phase. The depth of this unconformity (35m), the average dimensions of the mounds and the thickness of the overlaying sediments suggest that the mounds of the second cluster are older than the mounds of the first main cluster. Two gravity cores were collected on the West Melilla mounds. Core MD52G, collected on a 10m tall and 305m deep mound of the first cluster, is 5.58m long and displays silty bands (grain size mode ca. 7µm) alternating with dense CWC frameworks, which are more frequent and almost constant from the depth of 224cm to the bottom of the core (558cm). More frequent coral species are *Lophelia pertusa* and *Madrepora oculata*, with the latter dominating the shallower part of the core. Core MD51G, collected on a 35m tall and 370m deep mound of the second cluster, is 5.22m long and displays a continuous silty band (grain

size mode ca. 10 $\mu$ m) until the depth of 168cm. Below 168cm, scattered CWCs, mainly *Lophelia pertusa*, occur along the core, increasing in density and dimensions from around 430cm to the bottom of the core (522cm). However, no dense CWC frameworks were observed in the core. The preliminary insights from the core analysis confirm the different ages of the two clusters in the West Melilla Mound field (Lo Iacono et al., 2014), with the mounds of the second cluster being older and buried under at least 4m of fine sediments. Similar sediment textures have been described for the East Melilla Mounds by Fink et al., 2013. The drastic changes in sedimentary dynamics during the last sea-level rise, due to stronger interactions between Cape Tres Forcas and across shelf currents, could have increased the local sedimentation rates, favouring the burying of the mound clusters.

#### The Cabliers Mound:

The Cabliers Mound consists of a 15km long NNE-SSW oriented linear to sinuous mound/ridge system, from 60 to 100m tall and with the summit from 295 to 620m deep. However, this CWC ridge developed linearly above the edge of a large tectonic feature, suggesting a strong control of contour currents in its orientation, as also suggested by a deep erosive moat along its western flank. ROV videos recorded in the northern portion of the Cabliers Mound, show an extremely thriving CWC reef under a moderate to strong current regime, with large colonies of *Lophelia pertusa*, *Madrepora oculata*, cup sponges, gorgonians and anthipatarians. These observations are also confirmed by the infauna and epifauna collected in Rauchert grab samples, revealing an uncommonly increased biodiversity for this region. The thriving conditions of the CWC communities and their associated species make this portion of the Cabliers Mound a unique example of a “living and active giant CWC mound” for the Alboran Sea and likely for the whole Mediterranean. Two gravity cores were collected along the Cabliers Mound. Core MD69G, collected at a depth of 437m along the southern summit of the 60m tall mound, is 10.55m long and displays a rather high variability, with silty bands (grain size mode ca. 8 $\mu$ m) alternating with dense *M. oculata* and *L. pertusa* frameworks, large bands dominated by *Dendrophyllia cornigera*, solitary corals (presumably *Desmophyllum sp.*) or gastropods. Core MD70G was collected at a depth of 313m along the northern summit, where the mound is 88m tall. This core, 8.84m long, was collected where the thriving CWC reefs were observed in the ROV videos. The core shows an extremely dense and constant *M. oculata* and *L. pertusa* CWC framework almost along its whole extension, sporadically interrupted by thin fine sediment layers. Preliminary results from the high-resolution CT scans support this observation, with highest values of CWC density up to 28%. ROV videos and core analysis confirms that the Cabliers Mound is a peculiar feature both in the present day, with thriving large CWC communities on its summit, and in the past, with almost constant and very

dense CWC communities and unusual occurrence of *D. coringera* reefs and large solitary corals.

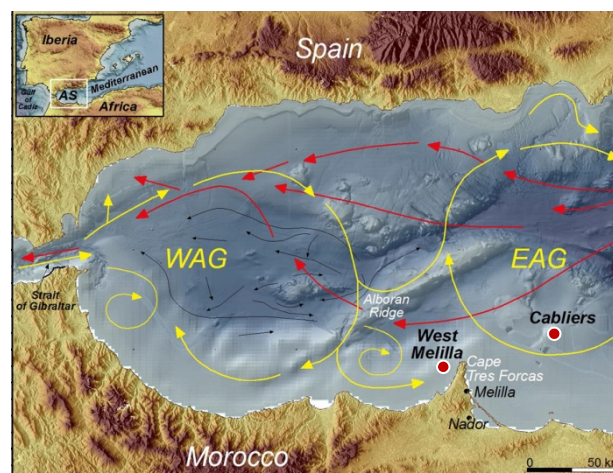


FIGURE 1. Topographic and bathymetric map of the Alboran Sea and location of West Melilla and Cabliers Mounds (red dots). The yellow lines indicate the MAW. The red lines indicate the LIW. The black lines indicate the deep Mediterranean Water. WAG: Western Alboran Gyre, EAG: Eastern Alboran Gyre. Inset: location of the Alboran Sea (AS).

## CONCLUSIONS

The recently mapped West Melilla Mounds and Cabliers Mound gave new insights in the distribution of CWC mounds in the Western Mediterranean and can help in better highlighting their large scale biogeographic patterns in the Mediterranean. The preliminary insights from the four gravity cores collected on the two mound fields suggest important differences between the studied areas, which show variable CWC compositions, density and cyclicity. The core MD70G suggests that the Cabliers Mound likely grew under exceptional permanent thriving environmental conditions, at least during the latest stages of its evolution, as suggested by the greater occurrence of dense CWC frameworks within the whole core.

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